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Research Article

EFFECT OF DIFFERENT SPACING'S ON GROWTH AND YIELD OF GUAVA (*PSIDIUM GUAJAVA* L.) CV. L-49

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Abstract: Guava (*Psidium guajava* L.) trees of cv. L-49 were planted at four different spacing's viz. 6.0mx6.0m; 4.5mx4.5m; 3.0mx3.0m and 1.5m x1.5m at research farm of Division of Fruit Sciences, Faculty of Agriculture , Udheywalla, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, in the year 2012.Data on stem height (m), stem girth (m), canopy spread (m) and yield/tree (kg) and yield/Ha (Qtls.) was recorded. After three years of growth the maximum tree height (3.69m) was recorded in closest spacing (1.5m X 1.5m) and it decreased with increase in plant spacing. Minimum tree height (2.91m) was recorded in widest spacing (6.0m X 6.0m). Maximum stem girth (0.42 m) was recorded in plants planted at a distance of 6.0m X 6.0m while minimum stem girth (0.30 m) was recorded with spacing of 1.5m X 1.5m. Maximum canopy spread (NS/EW) (3.18/3.11m) was recorded in 6.0mX6.0m spacing and minimum spread (NSXEW) (2.41/2.35) was recorded in the spacing of 1.5mX1.5m. After three years of growth, maximum yield/ tree (15.21 kg) was recorded under the spacing of 6.0mX 6.0m and minimum yield/tree was recorded under 1.5mx1.5m, whereas, yield/ha (129.33 q) was recorded in spacing of 1.5m X 1.5m followed by spacing of 3m X 3m (111.99q).

Keywords: *Guava, High density planting, Ultra high density, Yield, Growth*

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Introduction

Guava (*Psidium guajava* L.), the apple of tropics, is one of the most common fruits in India. It is the fourth most important fruit in area and production after mango, banana and citrus. Generally, guava is cultivated using traditional planting system, under which it is difficult to achieve desired levels of production, because large trees provide low production per unit area and need high labour inputs [1,2]. Moreover, large trees take several years before they come into bearing and overall cost of production per unit area is further increased, on the other hand ultra high density provides higher yields as well as higher economic returns per unit area in initial years and also facilitates more efficient use of inputs [3]. Hence, there is overriding need to improve the existing planting system. There is currently a worldwide trend to plant fruit trees on permanent high-density planting/meadow orchard and to manipulate tree growth using canopy management to control tree growth patterns and tree shape and maintaining high fruit production of desired size and quality [4]. In India concept of meadow orcharding or ultra-high density in guava was given by Dr. Gorakh Singh at Central Institute for Subtropical Horticulture, Lucknow, where guava was planted for the first time in India under this system which accommodates 5000 plants per hectare (1.0 x 2.0 m) with regular topping and hedging, particularly during initial stage. Thereafter area expansion under meadow orchard across the country increased day by day. More than 200 farmers have adopted this technology covering about 500 [5]. Different plant spacing's have been tried by various scientists for high density of guava. Kumawat *et al*. (2014) planted guava cv. L-49 at 2.0x2.0, 2.0x1.5, 1.5x1.5, 2.0x1.0, 1.0x1.5 and 6.0x6.0m. Brar (2010) planted guava cultivars Allahabad Safeda and L-49 at different spacing's *viz* 6×2 m, 6×3 m, 6×4 m and 6×5 m. All the workers have reported higher yield per unit area in ultra high-density planting with various growth regulating techniques *viz*. Dwarfing rootstocks, pruning and use of growth regulators. Due to absence of dwarfing rootstocks in guava, techniques that restrict the vegetative growth are important in management of tree canopy.

As guava tree respond well to canopy modification with respect to vegetative and reproductive growth, therefore, modification of canopy through pruning and use of certain growth regulators along with increasing the plant density may be steps to enhance the production efficiency. This will result into higher initial establishment cost as compared to traditional system of planting and also needs for a more professional and scientific approach for management compared to the conventional planting at wider spacing. Crowding and intermingling of branches may occur in later years which can result in poor performance of trees. Thus there is a need to standardize a sustainable planting system in guava which will give higher productivity per area without exaggerated higher initial establishment cost and that can be adapted by marginal farmers without using any sophisticated growth regulating techniques .Keeping in view this aspect an experiment was laid in order compare growth and yield differences between conventional density of 6.0mx6.0m, medium density of 4.5mx4.5m and 3.0x3.0m and ultra high density of 1.5mx1.5m.

Materials and methods

Field experiment was carried out at the Research Farm, Division of Fruit Science, Faculty of Agriculture, Udheywalla, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu & Kashmir, India, 180009 during the year 2012-2015. The site is situated in the subtropical zone at 32.73°N latitude and longitude of 74.87°E. It has an average elevation of 327 m from the mean sea level. Annual precipitation is about 1200 mm. Most of the rains are received during July to October (about 70 percent). The annual mean maximum and minimum temperature are 29.60°C and 16.70°C, respectively. Summer months are hot with temperature and humidity ranging from 23.50 to 35.50°C and 53.0 to 73.50 percent, respectively. The winter months experience mild to severe cold conditions with average temperature ranging from 6.5° to 21.70°C. December is the coldest month, when minimum temperature touches 4°C. The highest temperature is recorded in the month of June (45°C).

Table-1 *Effect of different spacing's on stem height (m), stem girth (m), canopy spread (m) and yield/tree (kg)*

Spacings	Stem Height(m)			Stem girth(m)		
	2013	2014	2015	2013	2014	2015
6mx6m	1.81	1.92	2.91	0.15	0.20	0.30
4.5m x4.5 m	1.66	2.05	3.12	0.14	0.21	0.33
3.0mx 3.0m	1.78	2.16	3.52	0.16	0.23	0.38
1.5m x 1.5m	1.70	2.31	3.69	0.18	0.28	0.42
C.D	0.09	0.26	0.23	N.S	N.S	0.03

Table-2 *Effect of different spacing's on canopy spread (m), yield/tree (kg) and Yield/ Ha (Qtls.)*

Spacings	Canopy spread (m) (NS/EW)			Yield/ tree (Kg)	Yield/ Ha (Qtls.)
	2013	2014	2015	2015	2015
6mx6m	2.01/1.92	2.78/2.72	3.18/3.11	15.21	42.24
4.5m x4.5 m	1.94/1.90	2.66/2.53	3.11/3.06	12.10	59.75
3.0mx 3.0m	1.88/1.83	2.09/1.97	2.92/2.86	10.08	111.99
1.5m x 1.5m	1.70/1.66	1.94/1.90	2.41/2.35	2.91	129.33
C.D	0.077/0.152	0.189/0.161	0.299/0.340	0.74	18.12

The daily maximum and minimum temperature and evaporation rate rise from March onwards. Experiment was laid out in randomized block design and guava plants of cv. L-49 were planted in August in four blocks with four different spacing's: 6.0mx6.0m(T1); 4.5mx4.5m (T2); 3.0mx3.0m (T3) and 1.5m x1.5m (T4) replicated five times. Trees were pruned after six months of planting by topping upto 50 cm from the ground and all the side shoots were cleared. Thereafter all the plants were pruned after every six months by removing 50 % of the growth on main stem as well as on side branches. The data on stem height (m), Stem girth(m) and Canopy spread (m)was recorded in the month of September each year, whereas data on yield/tree (Kg) and yield/Ha (Qtls.) was recorded in the third year of planting. The data on stem height and canopy spread (NS and EW) was recorded using meter scale. Stem girth(m) was recorded by Vernier calliper. Yield per tree was calculated by weighing all the harvested fruits on electronic balance and expressed as Kg/tree. The yield per hectare (Quintals) was calculated by multiplying the yield per tree with the number of plants per hectare.

Results and Discussion

After first year of planting maximum tree height (1.81m) was recorded in guava trees planted at a distance of6.0m X 6.0m but in the later years (2014 and 2015) guava trees planted at 1.5m X 1.5m showed maximum tree height (2.31m and 3.69m) whereas after three years of planting tree girth was recorded to be maximum in the plants spaced at 1.5m X 1.5m (0.42m) and minimum in plants with spacing 6.0m X 6.0m (0.30m). Maximum canopy spread NS (2.01 to 3.18m), EW (1.92-3.11m) was observed in wider spacing (6.0m X 6.0m) and the closest spacing of 1.5m X 1.5m showed minimum canopy spread of NS (1.70 to 2.41m), EW (1.66 to 2.35m). Kumawat *et al*. (2014) have also reported increase in plant height of guava with increase in plant density and a decrease in spread of plant with increase in plant population. Kumar and Singh (2000) have also reported decrease in girth and volume with increasing tree density in trees of guava cv. Allahabad Safeda. A possible explanation for these results is the competition for water and nutrients [6] but mainly the competition for light [7] being under high plant densities plant canopies overlap into the rows reducing light incidence on leaves. Consequently, great part of canopy contributes little or nothing to the synthesis of carbohydrates necessary for growth. Further under closer spacing increase in plant height might be due to competition for light because of insufficient space. Similar results have been reported by various workers in various crops (Gaikwad *et al*. ,1981; Mitra *et al*. 1984; Kundu *et al*. ,1993 in guava; Kumar *et al*., 2010 in apricot and Dalal *et al*., 2012 in Kinnow) [8-12]. Yield of individual tree showed decreasing trend whereas yield/ha showed an increasing trend with increasing tree densities. Yield / tree was lowest in closer spacing of 1.5m X 1.5m(2.91 kg/tree) and increased with increase in spacing and was highest in trees planted at 6.0m X 6.0m (15.21kg/tree). An increase in yield / tree in wider spacing might be due to maximum radiation interception which in turn had more efficient photosynthetic activities resulting in high rate of net photosynthesis which enabled trees to produce more fruits with higher weights, however in closer spacing's less radiation interception on per tree basis resulted into severe competition for metabolites which resulted into fruits with less weight. Estimate yield/ha was maximum (129.33 qtls./ha) in closer spacing of 1.5 m x 1.5m and this yield was statistically at par (111.99qtls./ha) with spacing of 3.0 m x 3.0 m and minimum was recorded in wider spacing (42.24qtls./ha) of 6.0 m x 6.0 m , it was due to the fact that number of trees increased from with increasing planting densities (278 trees/ha to 4444 trees/ha). Tiwari *et al*. (2018) [13] also reported that closer spacing in guava results into higher yield due to a greater number of trees per unit area. Earlier worker has also reported that close spacing decreases fruit weight and size but considerably increases yield per unit area (Mitra *et al*. 1984; Kundu *et al*. 1993). Similar findings have also been reported in guava by Mohammed *et al*. (1984); Chundawat *et al*. (1992); Kalra *et al*. (1994) and Bal and Dhaliwal (2003) [14-17]. Thus, it was concluded that a spacing of 3.0 m x 3.0 m can also give high productivity with less establishment and maintenance cost. Medium density spacing of 5 × 5 m has been reported optimum, economically viable, easily adoptable and practically acceptable by the farming community by Poornima *et al*. (2018) in mango [18]. There is further need to conduct research on medium density planting in guava and to compare its economics to that of ultra high density planting, so that a sustainable planting system can be standardised for guava.

Application of research: Standardised spacing's will help orchardists' to obtain maximum profit from High density plantings of guava.

Research Category: Horticulture

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Abbreviations: HDP: High density planting, NS: North South, EW: East West

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Study area / Sample Collection: Experimental orchard, Division of Fruit Science, Faculty of Agriculture, Udheywalla, Jammu.

Cultivar / Variety name: Guava (*Psidium guajava* L.) - L-49

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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